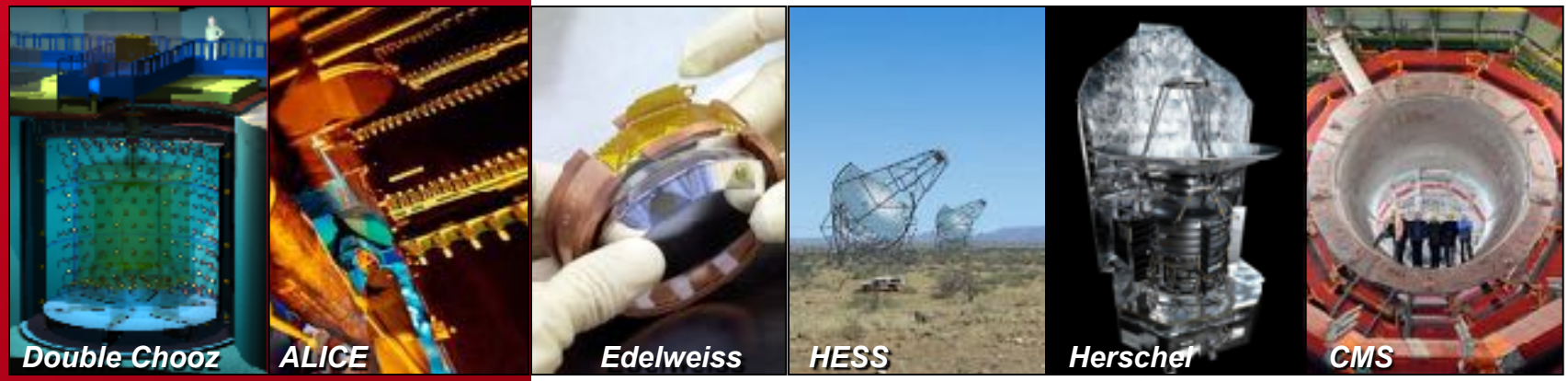
DE LA RECHERCHE À L'INDUSTRIE

Possible Saclay contribution to sPhenix



Déchiffrer les rayons de l'Univers

Stephan Aune

June 2017, sPhenix collaboration meeting

OUTLINE

- Irfu and Micromegas
  - Bulk technology
  - Irfu MPGD workshop
- TPC experiments
  - T2K
  - ILC
- Tracker experiments
  - Asacusa Micromegas Tracker
  - CLAS12
- Irfu @ Sphenix

IRFU, MICROMEGAS, SEDI AND …ME ☺️

IRFU: Institute of research into fundament laws of the Universe: ~ 680 permanents + 120 students

Sedi: The Electronics, Detectors and Computing Division: ~ 140 permanents

In Sedi two Detector groups: ~40 Perm. Mostly on gaseous detectors, Micromegas (I. Giomataris)

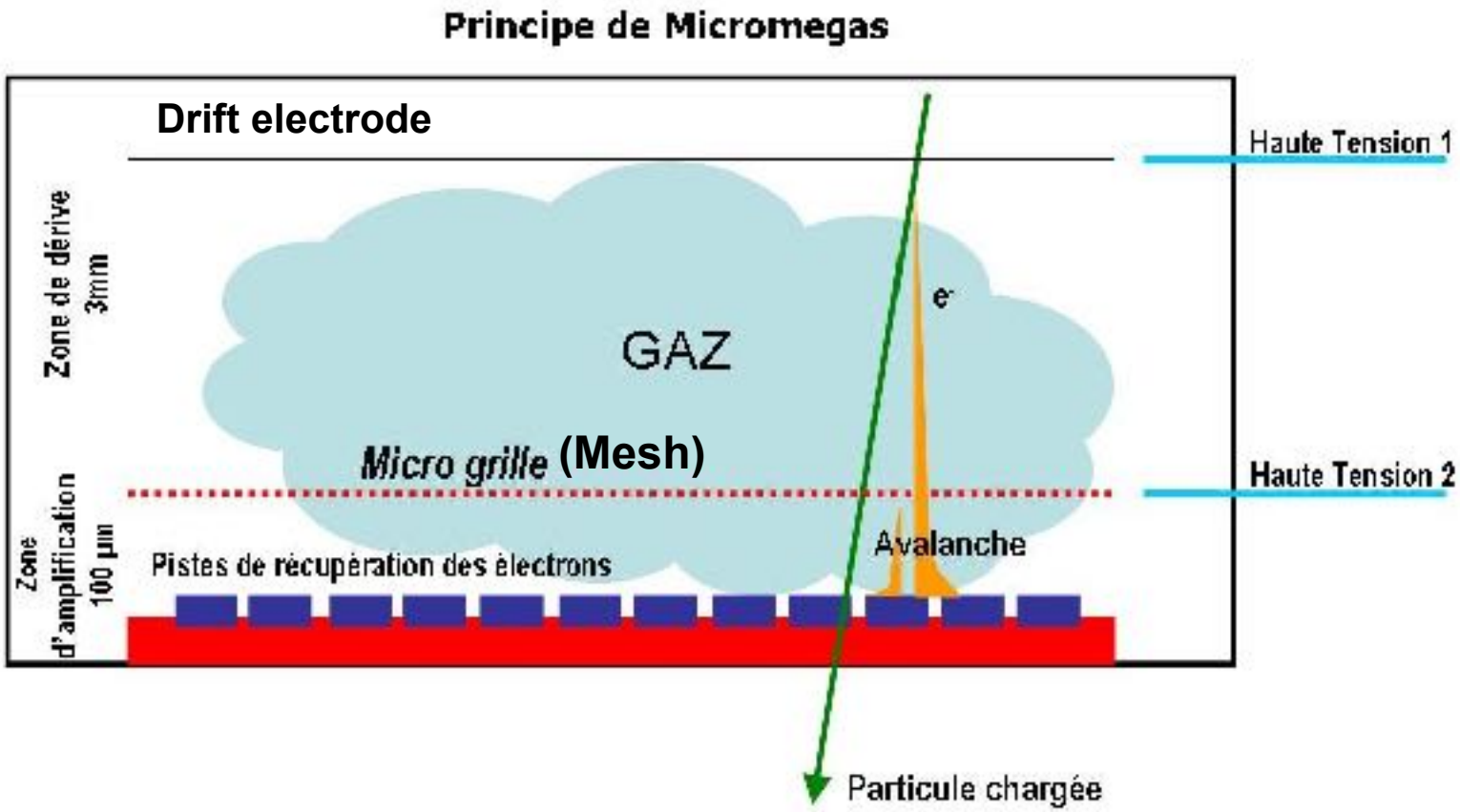
Since ~15 years, lot's of Micromegas experiment and R&D was done.

Stephan Aune: Mechanical and thermal engineer

~10 years on CCD cameras, ~15 years of Micromegas

Project leader: CLAS12, Bulk Lab

MICROMEGAS BULK: pillar holding the mesh on PCB



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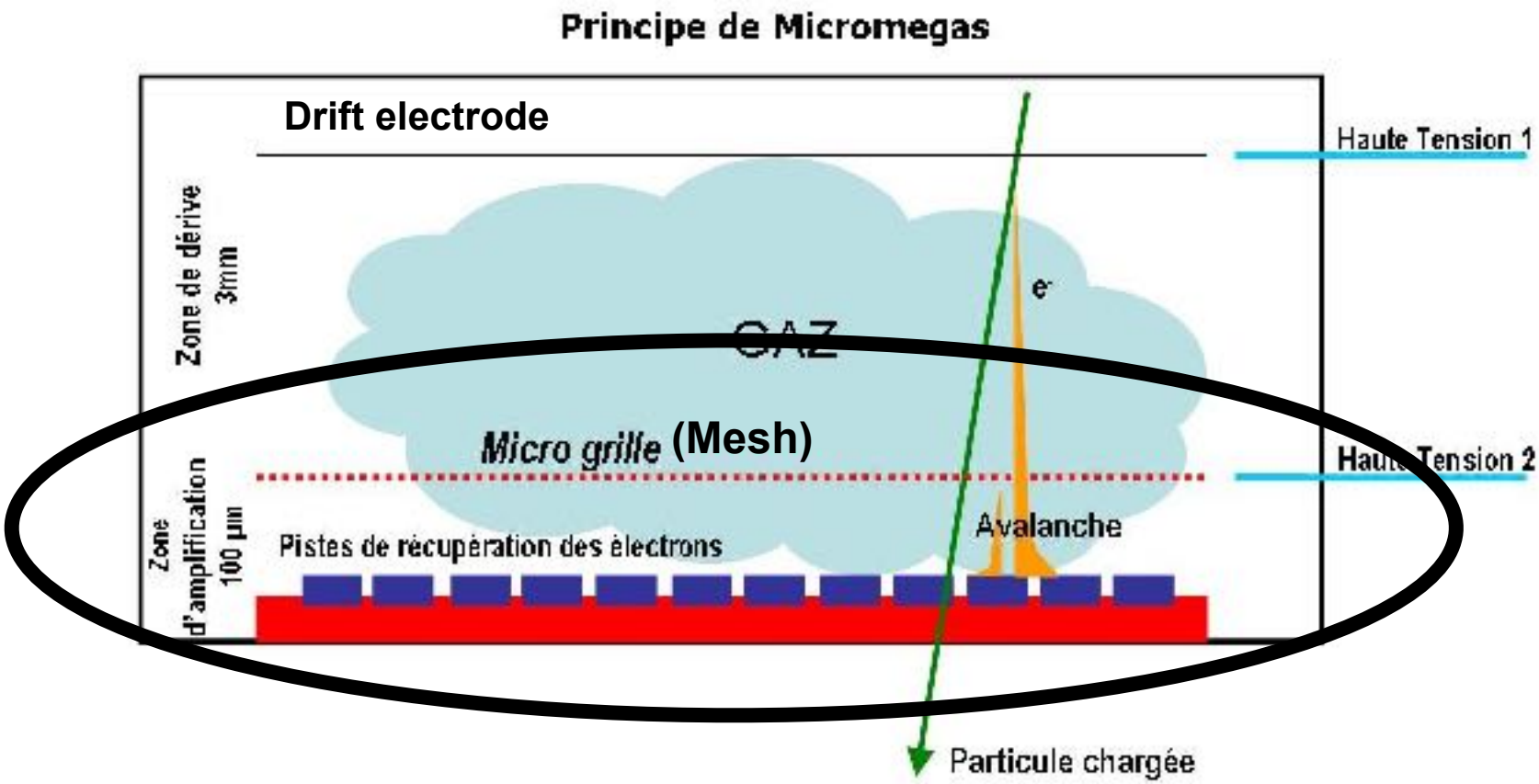

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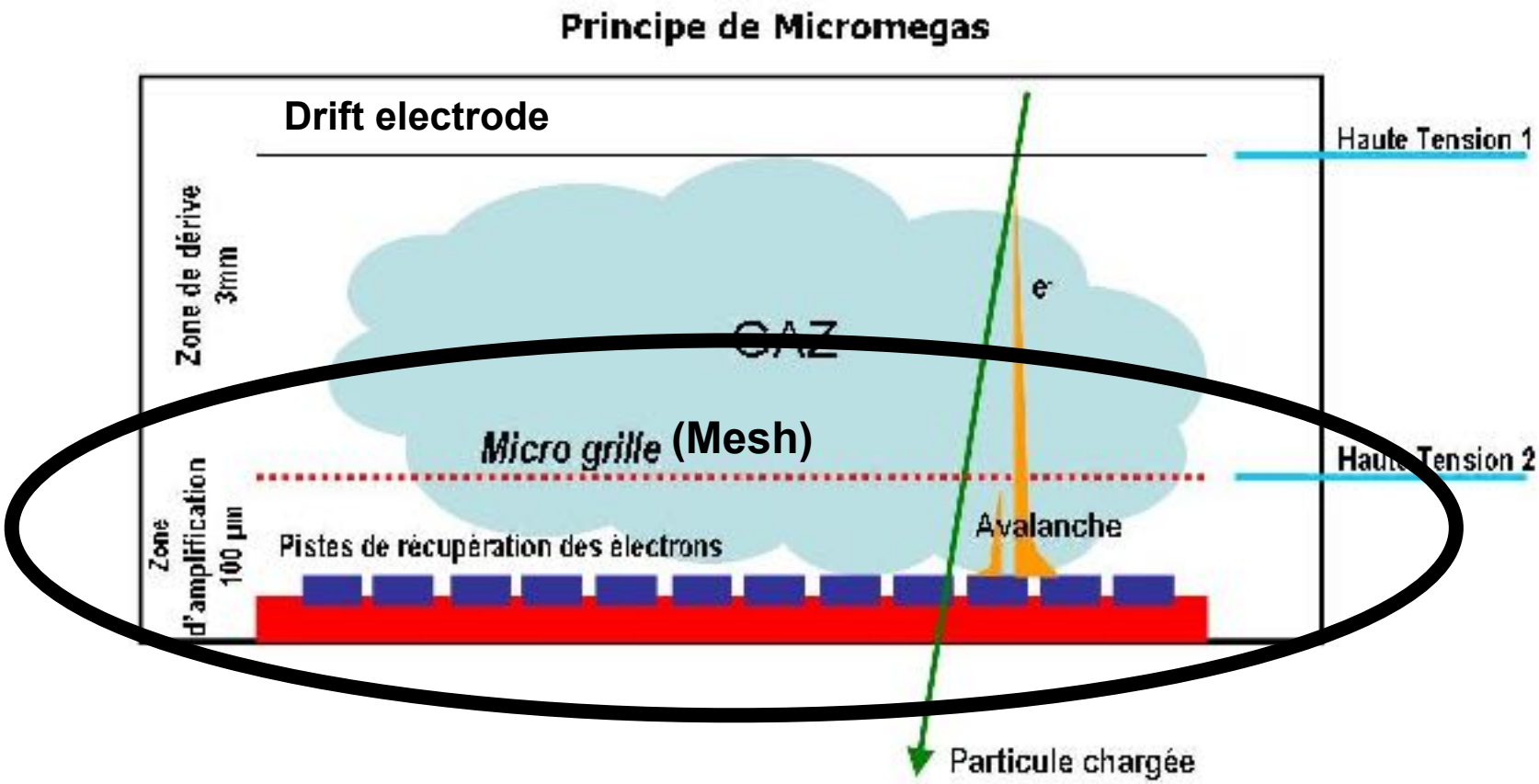

Anode (PCB) + embedded Mesh **=** Micromegas **BULK** :

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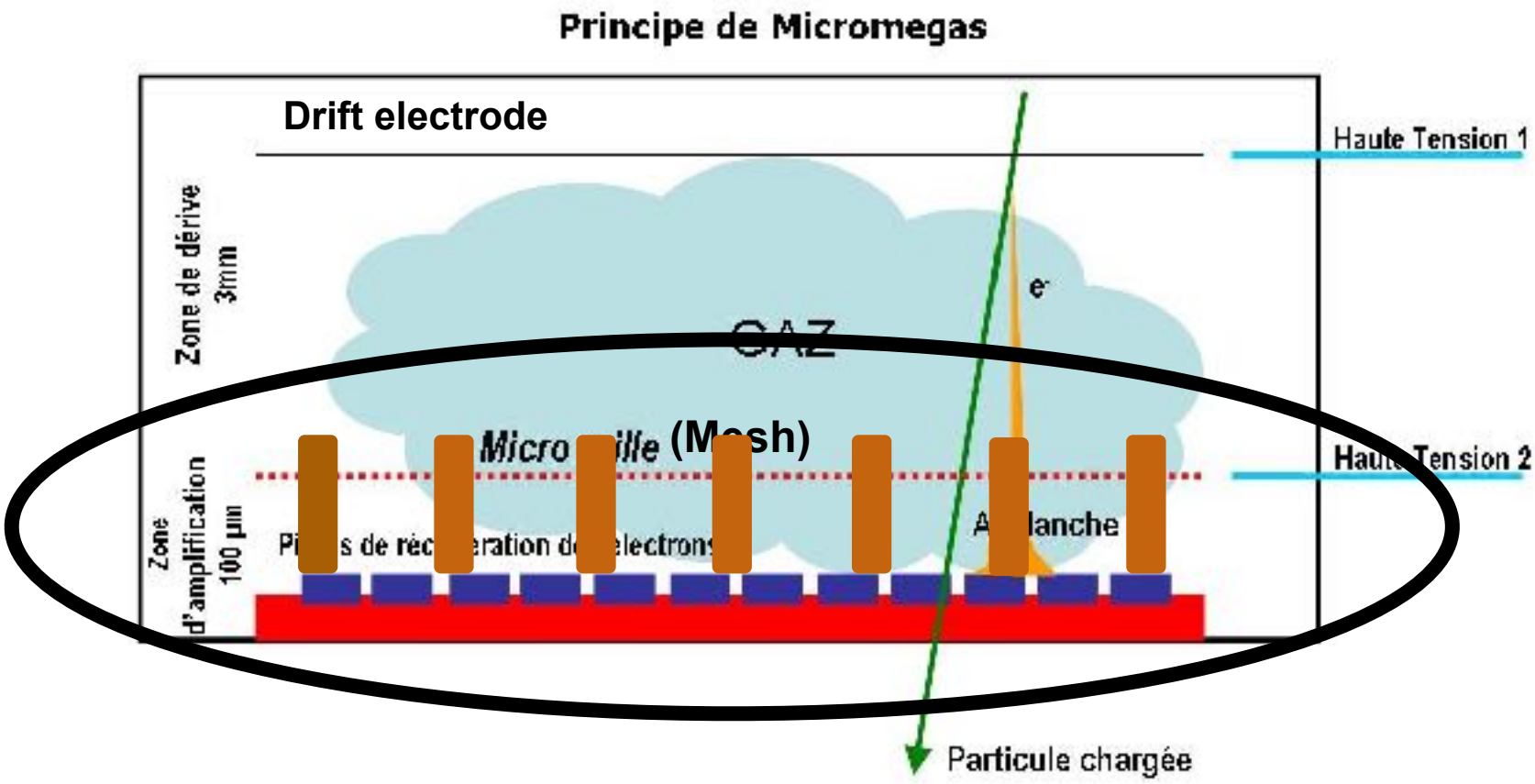
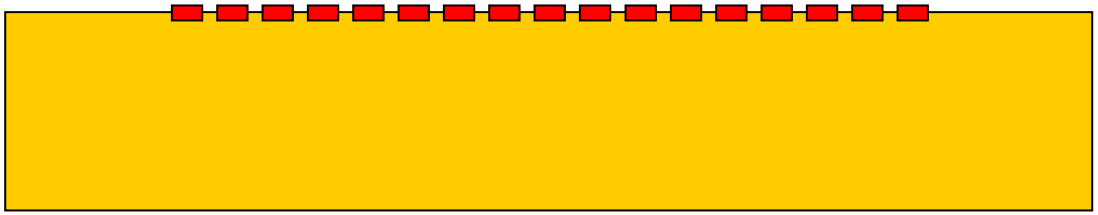


Anode (PCB) + embedded Mesh **=** Micromegas **BULK** :

BULK MANUFACTURING

1) PCB cleaned (strips, pixels,…)

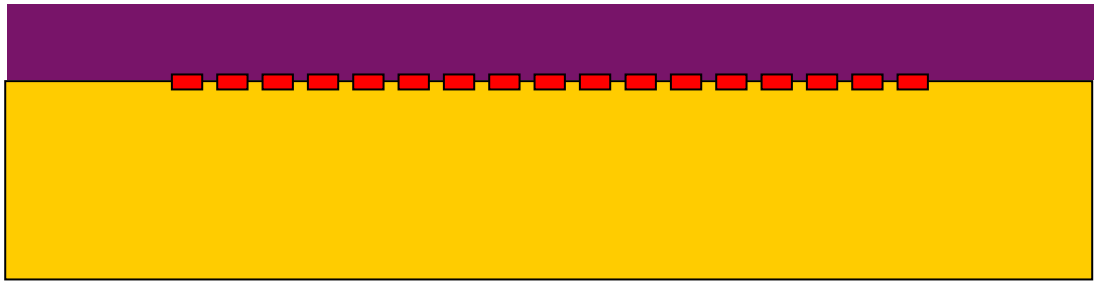


PCB

BULK MANUFACTURING

1) PCB cleaned (strips, pixels,…)

2) Photoresist lamination (50 à 200 µm)



PCB

BULK MANUFACTURING

1) PCB cleaned (strips, pixels,…)
2) Photoresist lamination (50 à 200 µm)
3) Stretched mesh deposition (woven SS 25 µm, 500 LPI)

BULK MANUFACTURING

1) PCB cleaned (strips, pixels,…)
2) Photoresist lamination (50 à 200 µm)
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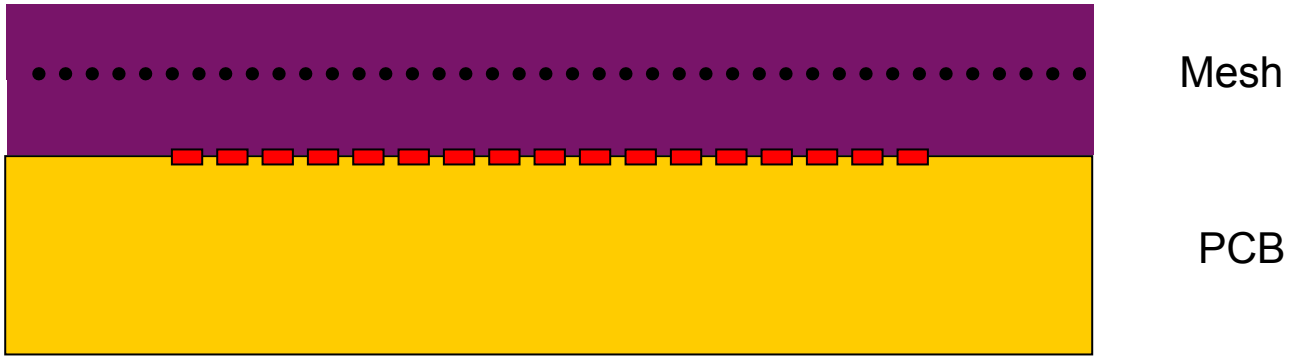
4) Photoresist lamination (50 µm)



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1) PCB cleaned (strips, pixels,…)
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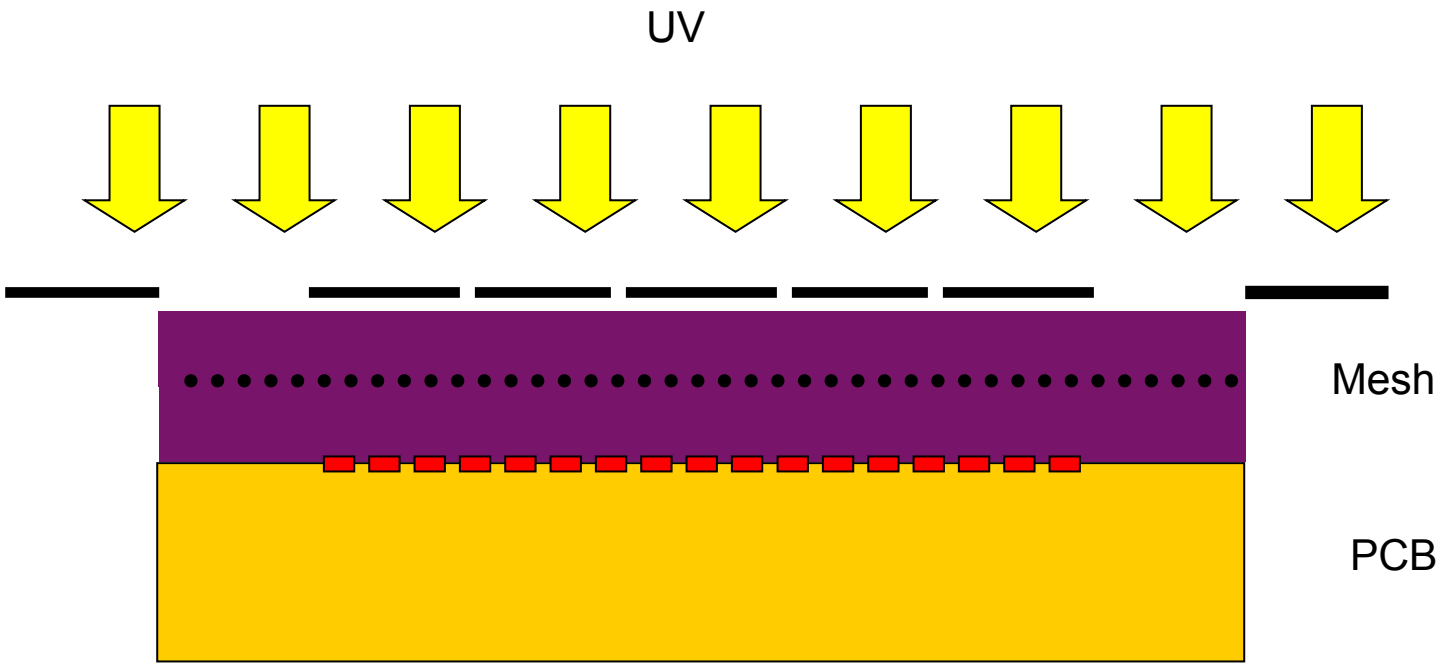
5) UV Insolation through a mask (frame and pillar pattern)



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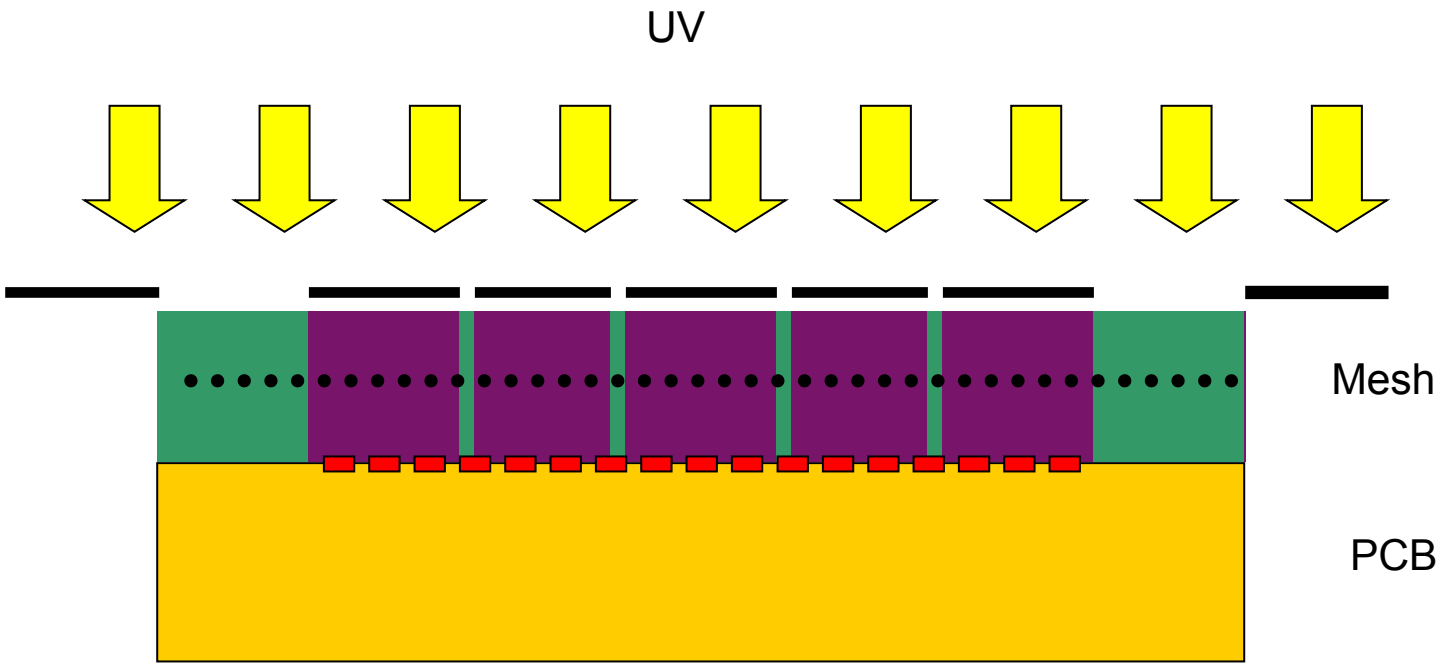

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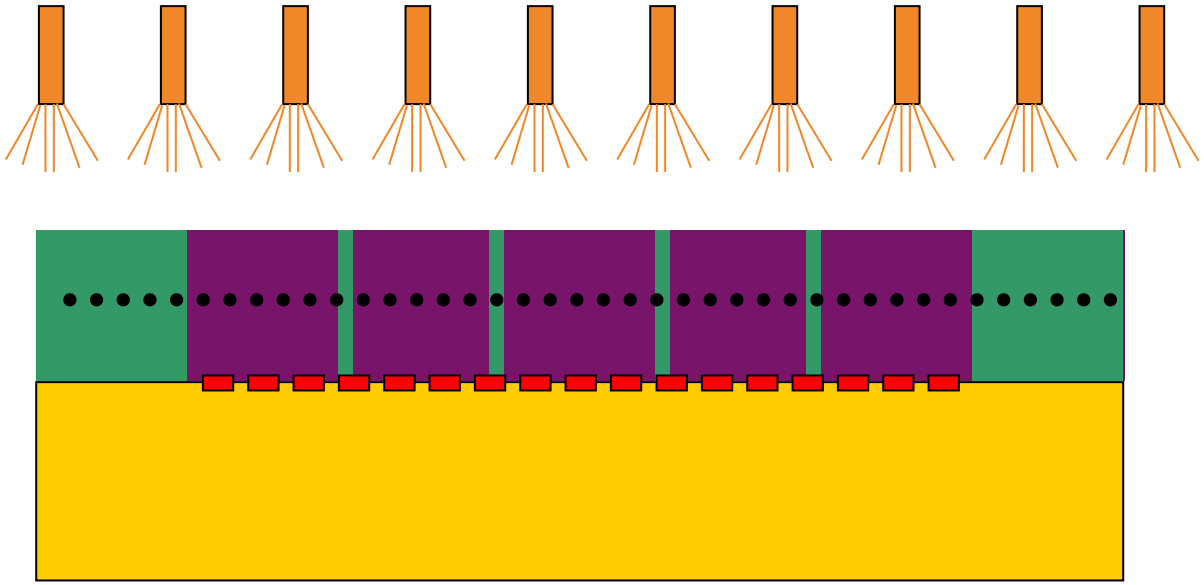
6) Development (carbonate sodium)



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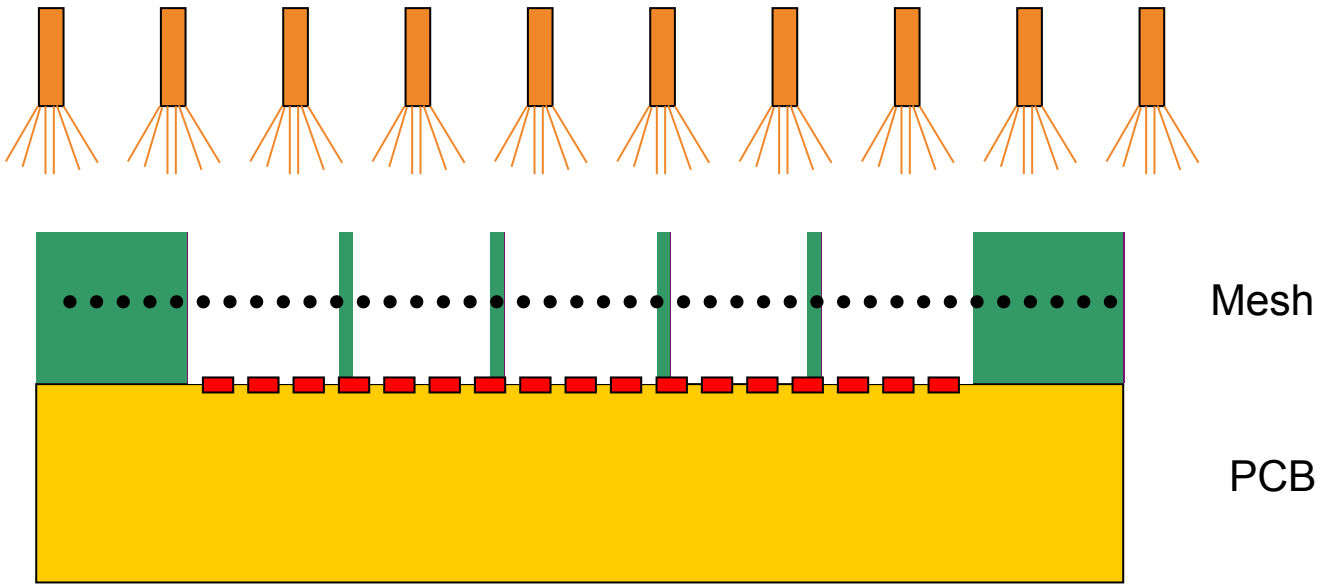

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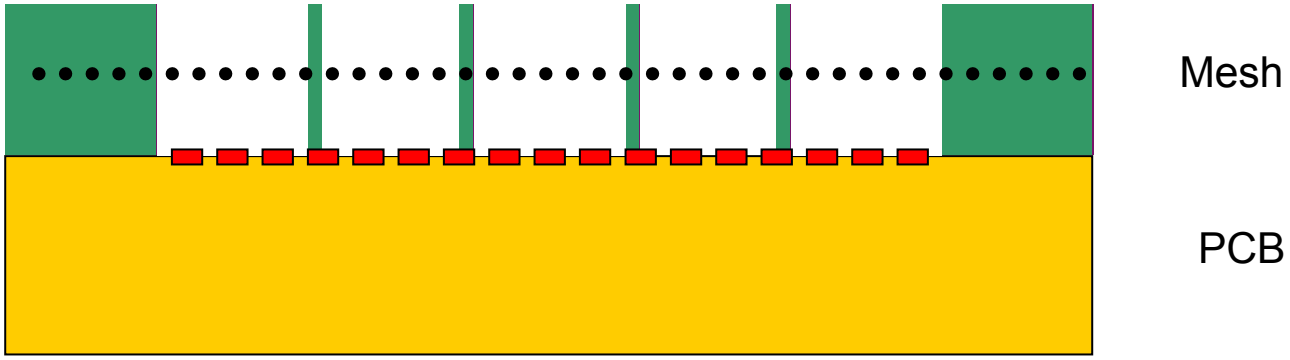

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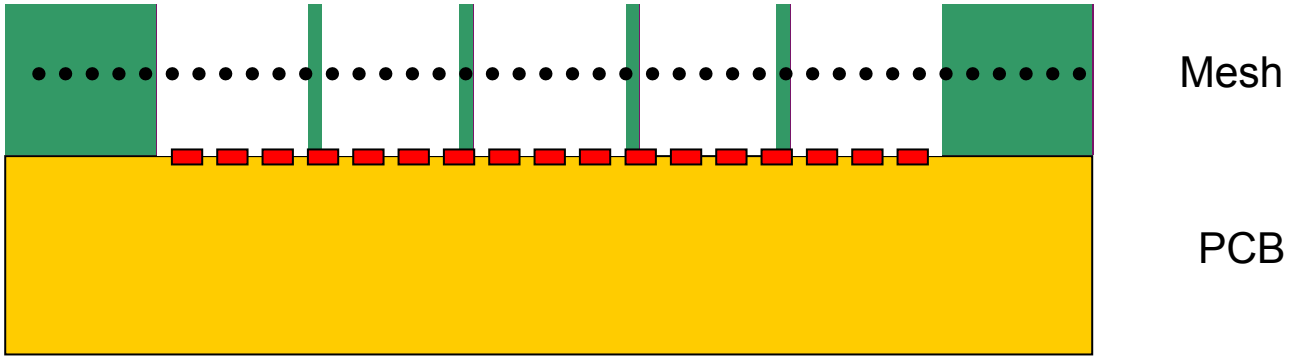
7) Curing (oven)



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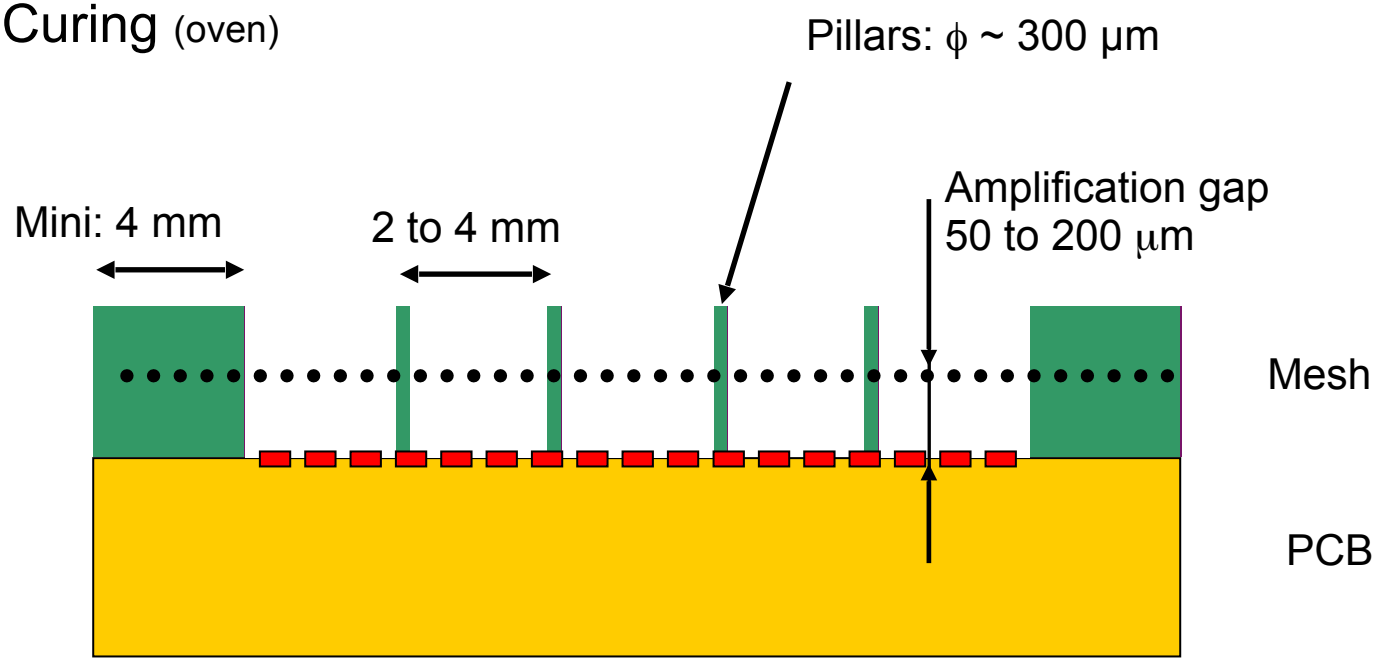
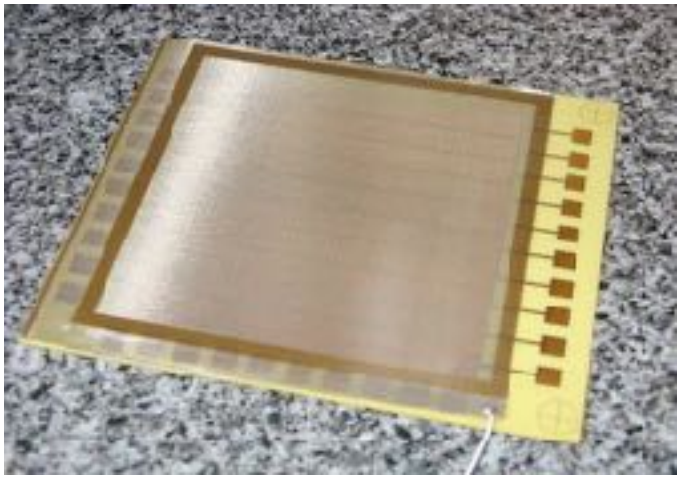
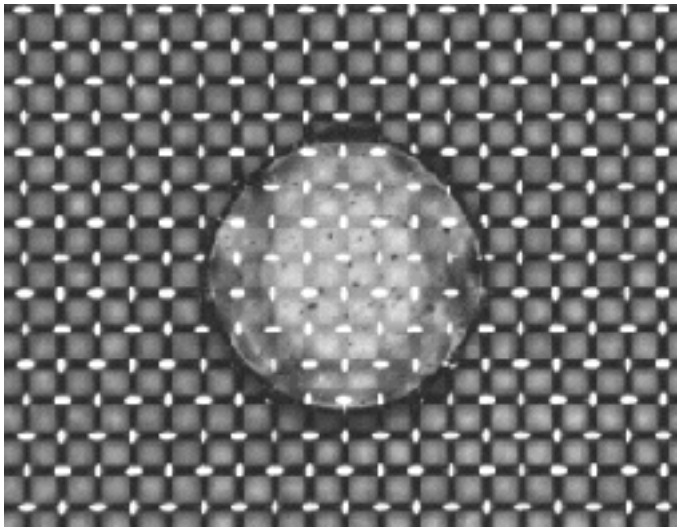


BULK ADVANTAGES

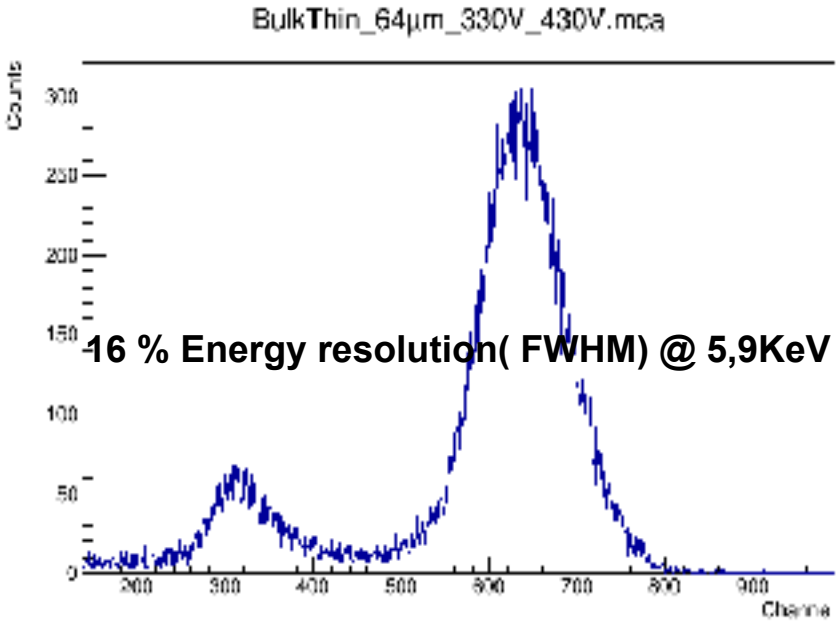
BULK :

- Robust !!!
- Curve (flexible PCB)
- Low X0 possible
- Realization time low, ~2 day
- Industrialization possible
- Good resolution
  - Spatial & temporal, like Micromegas
  - Energy ~ 16 % @ 5.9 Kev





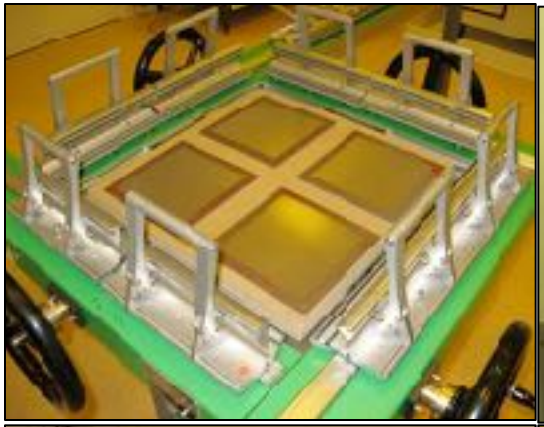
300 µm pillar and woven mesh

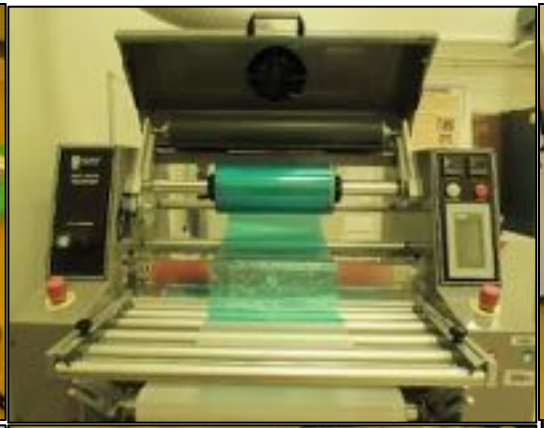


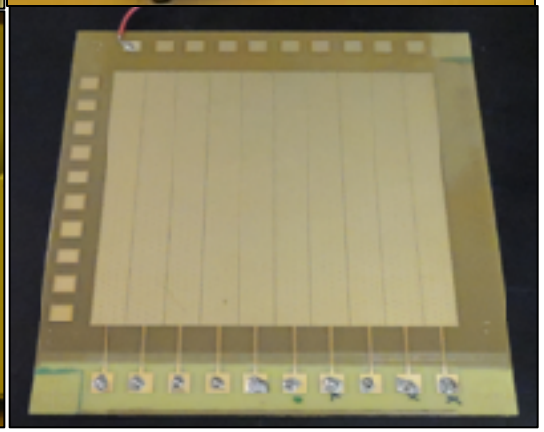
16 % Energy resolution(FWHM) @ 5,9KeV

IRFU MPGD WORSHOP, aka bulk lab

Bulk lab: Grey room of 64m² with tools to realize Bulk up to 60x70 cm²







Screen printing for resistive strips

- Screen mesh = pattern to print
- resistive paste (conductive, isolate)
- Substrate (PCB, Mylar, Kapton, glass)

300 µm resistive strip

Resistive layer remove the spark and spread the charge.
Need very clean environment.

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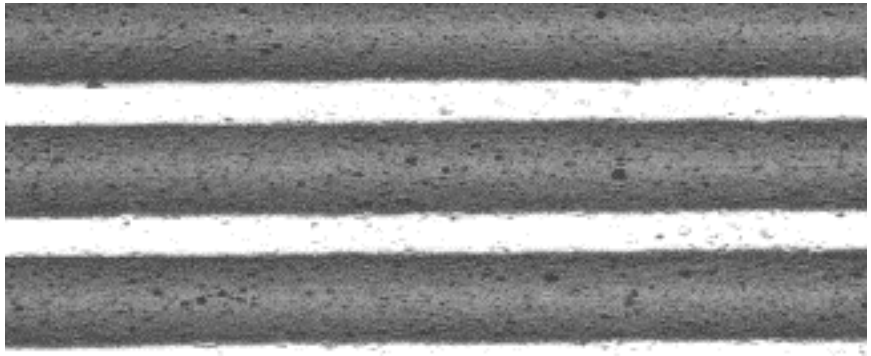


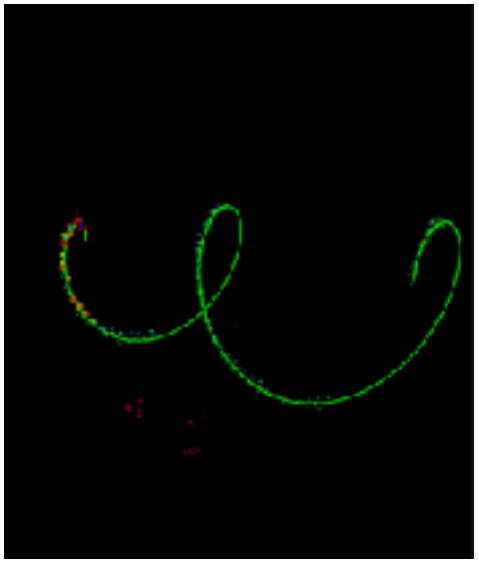
300 µm resistive strip

Resistive layer remove the spark and spread the charge.
Need very clean environment.

TPC: BULK REALISATION

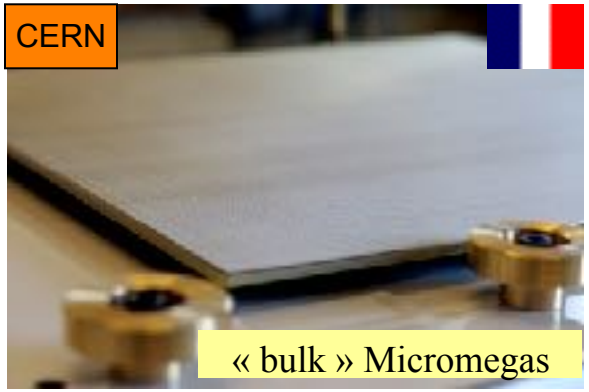
For MSU AT-TPC the bulk lab made several prototype and the final TPC (diam ~500 mm)

Three readout were made (one spare + one bulk spare), one is used for physics



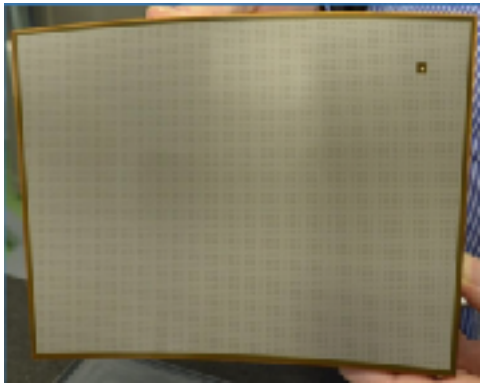
TPC: T2K

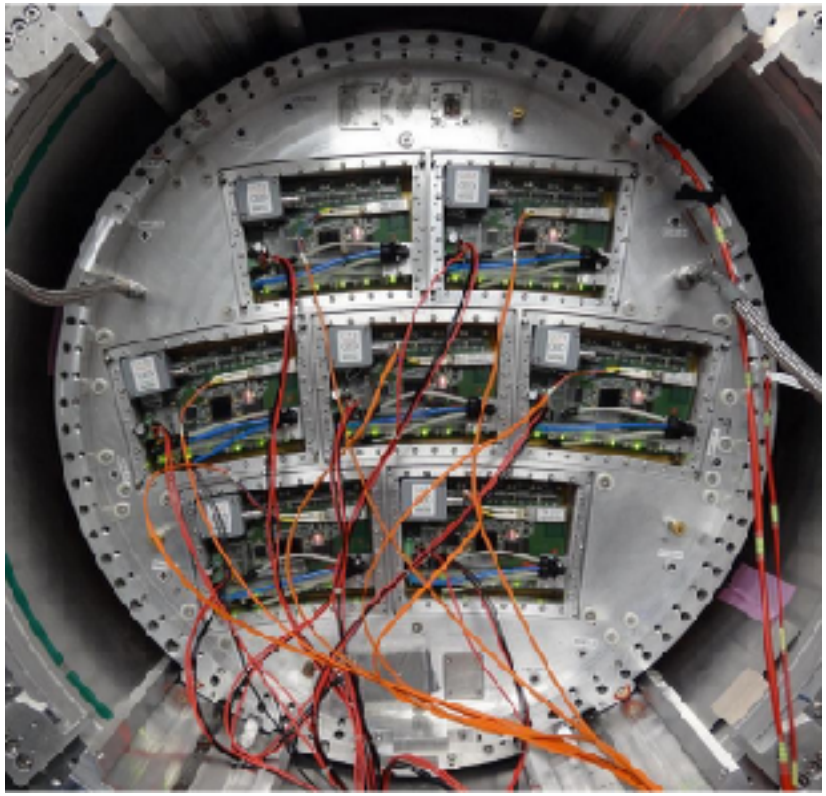
Saclay involved in Bulk specification, assembly and characterization + Front End

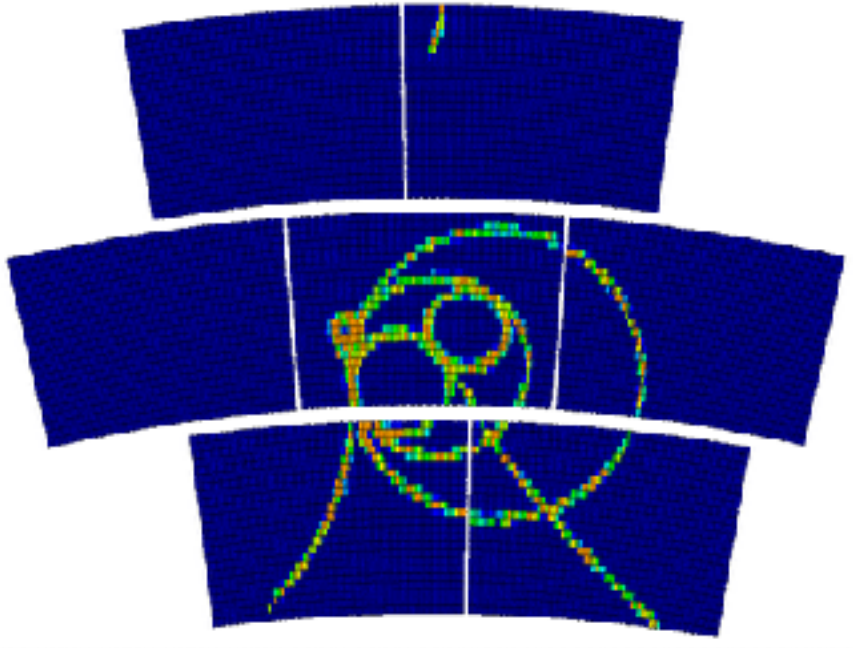


ILC TPC PROTOTYPE

Saclay team tested several CERN prototype and used 7 resistive micromegas readout with AFTER electronics in beam test.



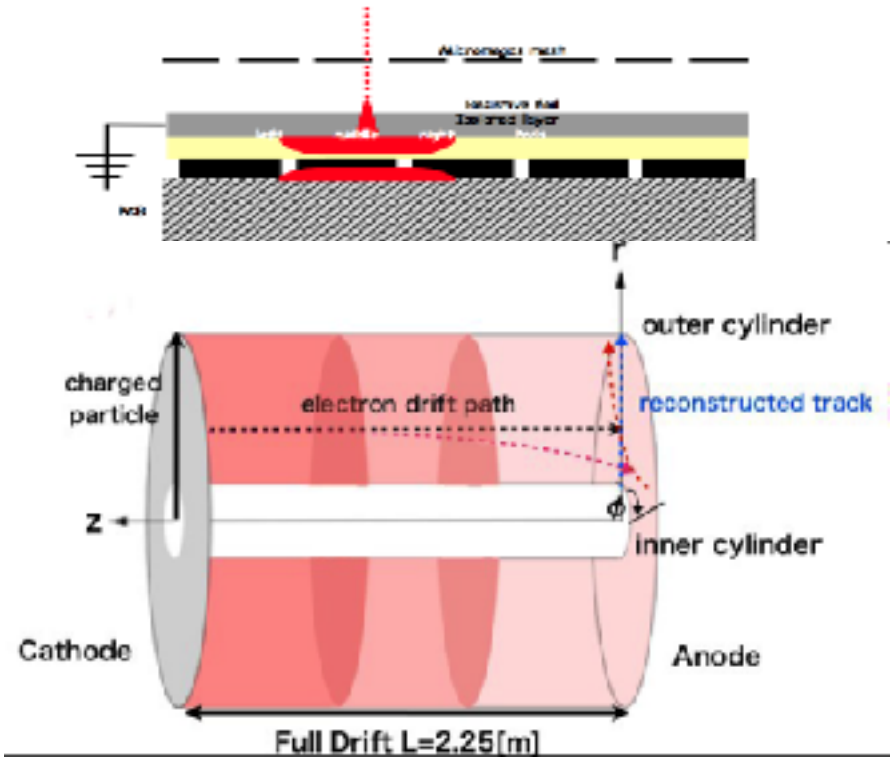




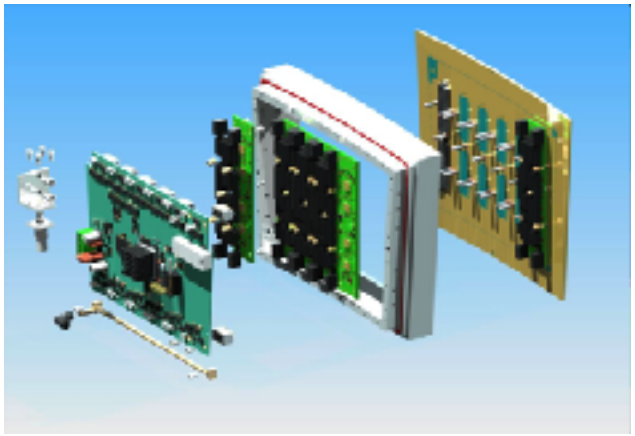
ILC TPC PROTOTYPE

Pad size limits transverse resolution

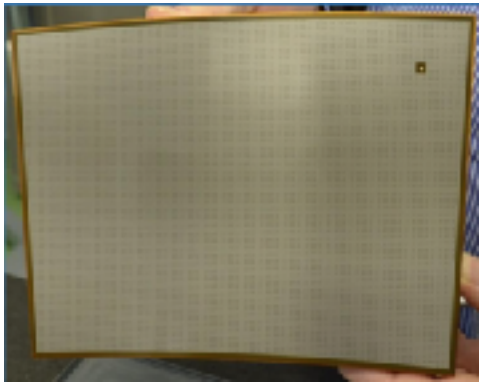
- use resistive anode to spread charge
- pad 3x7mm^2, small N_{ch}



Gating for IBF



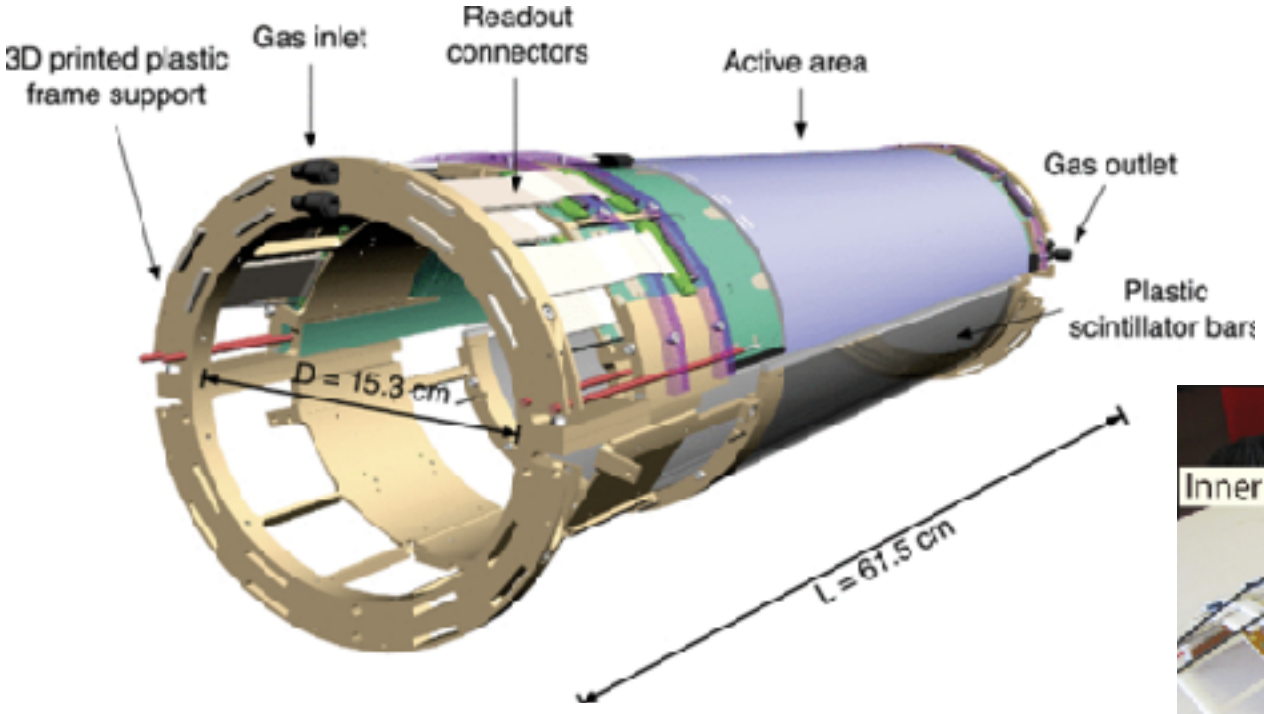
Fully integrated design

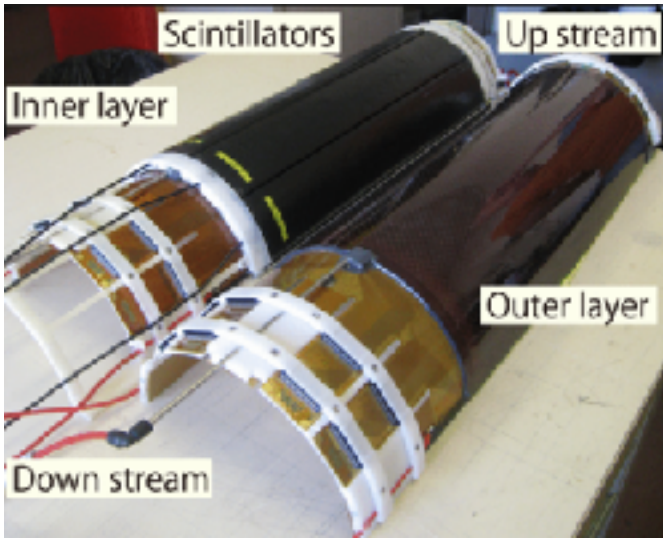


Bulk with charge-dispersing resistive anode

ASACUSA MICROMEGAS TRACKER

AMT is a realization (contract) for CERN/Riken anti hydrogen search
It is a tracker made of two 2D layer with a layer of curved scintillator
R&D made in one years, tracker in 9 month!

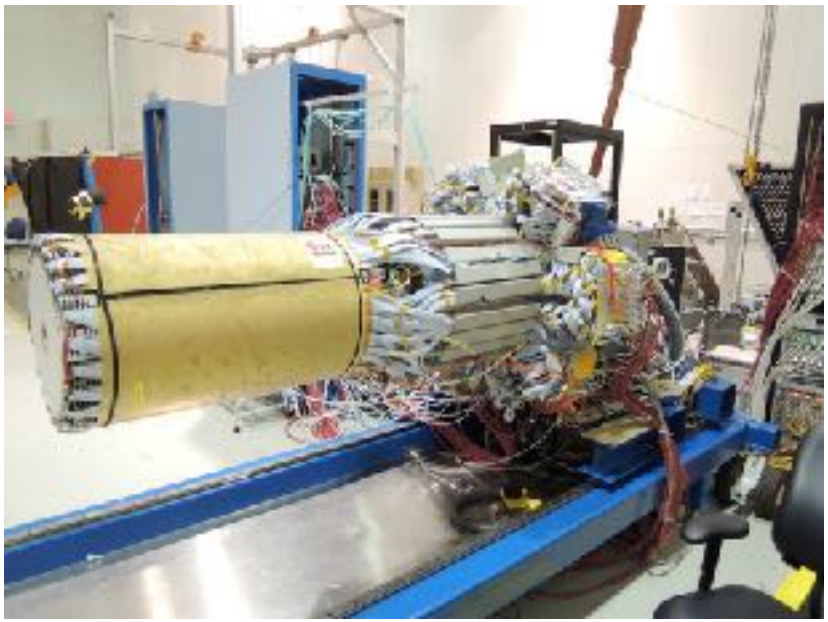




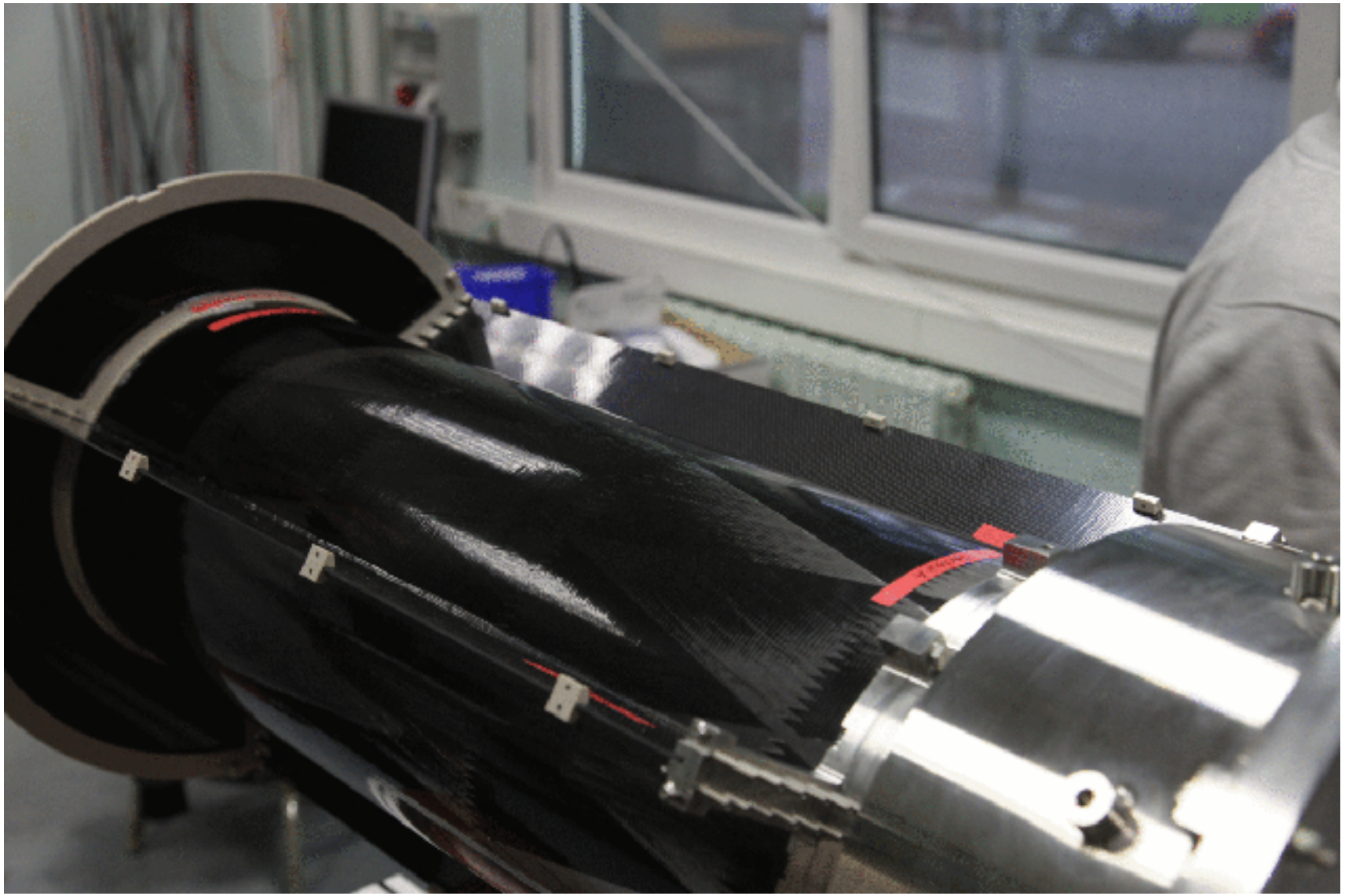
CLAS12

Saclay started R&D on curved Micromegas in 2009.

In June 2017 a full tracker is installed in Jlab with six curved layer (~3 m²) and 6 disks (~1 m²) of resistive micromegas for 24k channels on remote front end electronics.



CLAS12, 6 LAYER ASSEMBLY



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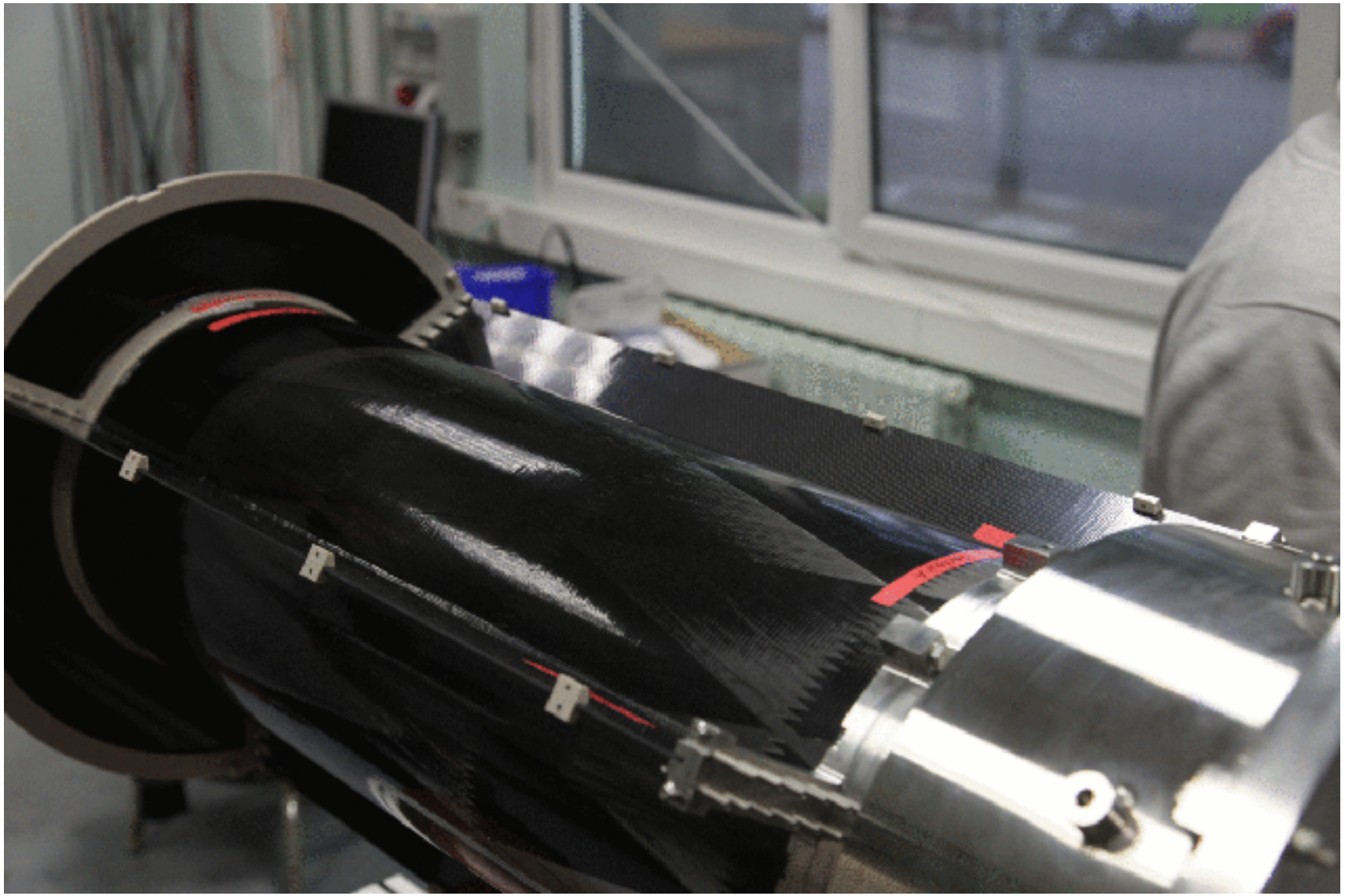

SACLAY IN SPHENIX

Saclay possibilities for sPhenix

- TPC micromegas readout (2x8 sectors)
  - Knowhow in Micromegas bulk in TPC
  - Interest in IBF R&D (double mesh bulk, hybrid GEM+μm)
    - IBF test bench in 2018 in Saclay
  - Facility for prototype and full realization of readout

- Tracker and TPC monitoring: outer barrel tracker (40 tiles)
  - Unique knowhow in curved micromegas
    - Quite easy to curve, space needed ~5 cm
  - Facility for bulk prototype and full realization of micromegas

- Forward upgrade (n disks)
  - Knowhow in Micromegas bulk and μM+Gem
  - Facility for prototype and full realization of micromegas

Until ~2019 (CERN Long Shutdown) manpower mostly available for micromegas realization, less for integration. No manpower for new FE, use of existing chips (SAMPA, DREAM,…)

MICROMEGAS IN BNL/STONYBROOK/…

IN 2017-2018:

We could produce in-house micromegas prototypes board, test and characterize them.

But also ship them to US to initiate a knowhow on micromegas detector at BNL, Stonybrook,…

A lab that tests Gem can easily also work for Micromegas. The Gem readout PCB can be transformed into a micromegas.

If micromegas is adopted for sPhenix we would need to built some consortium, for characterization, integration, maintenance.